

TEST PLAN

Title: Cavity Gradient Stressing - D

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Date Submitted: April 16, 1996

Revision Number: Rev. 4, May 22, 1996

Brief Purpose of Test

To establish current gradient performance limitations of the SRF cavities in two sets of three zones.

Because operation of most klystrons have been constrained for economic reasons, most cavities have not been exercised at high gradient for several years. We need to reconfirm the performance observed during commissioning and gather data to support loosening the constraints which have contributed to setting "GSETmax" in the past.

This is necessary to maximize the flexibility of 4 GeV operation and to support energy upgrades.

To keep from setting the AC power demand charge, the total $I \cdot V$ for all klystron power supplies in the machine must be kept less than 2.0 MW. This implies, for example that 16 zones may be stressed simultaneously at 11.6 kV taps with 1.23 A cathode current, if all other zones are in RF OFF.

Beam Conditions Required

No beam

Time Required

4 hours

Preferred Time of Test

none

Staff Required to Execute the Test (including contact info)

RF maintenance techs (2) on-calls

operators + Kurt Brown x7441 for initial downloads and recovery

B. Yunn, M. Drury,
problems contact Charlie Reece x7645

Controlled Access Requirements

N/A

Hardware and/or Software Changes Required

Change HPA tap settings to 11.6 kV. - Contact **rf team on call**

While HV is off to change tap settings, must download new GSETmax values. **K. Brown**

At the conclusion of the test, the changes are to be reversed.

Test and Setup Procedures

PRELIMINARY SETUP STEPS

1. Prepare “Set 1 and Set 2” of DRVH values to be used during the test. - **C. Reece**
Note current DRVH values, call it “Set 0”
See tables below
2. Prepare monitoring script to log data during test. - **K Brown**
GSET, CFQR, CRFP, CWWT, GMES,...
Prepare new download code to increase GSETmax to 14.0MV/m- **K Brown**
3. **Experience indicates that one person can exercise two zones at a time. Any number of zones may be stressed simultaneously.**
4. Beam off
5. Increase tap setting to 11.6 kV
6. Download new code with raised GSETmax limits.
7. Reestablish RF on

TEST PROCEDURE STEPS

1. **Initiate logging script.**
2. **Call up “highgradm” screen @ user/user1/reaves/dm/*.adl. This is a menu screen.**
3. **Re-establish tuned operation of cavities in the modules at GSET = DRVH. Raise the DRVH values to Set 1.**
4. **Set the HOPR values to Set 1.**
5. **Raise GSET values by using the slider controls on the CMStress panel. The default routine is to make adjustments at 25% of the full scale of the slider. [Limits for each cavity will be preset by the LOPR and HOPR .]**
6. **Allow the tuners to settle after each change.**

7. **Note any faults and the conditions during fault. Logging routines will capture details, but try to notice real-time trends. If the same type fault occurs three times at the same field level while the cavity is tuned, do not attempt to raise gradient of that cavity any further. Turn that cavity down by 0.2 MV/m and leave fixed for the balance of the test.**
8. **If a cavity's tune seems uncontrolled, have rf tech or other qualified person tune up rf module parameters and consider manual tuning. [See the BRIAM SOS diagnostic process at <http://recycle.cebaf.gov/~doolitt/briam/sos.html>]**
9. **When GSET values have reached DRVH Set 1 values (slider controls at 100%) or otherwise maxed-out, leave GSET values stable for 1 hour, resetting all faults, if any.**
10. **Raise DRVH to Set 2 values for cavities that have not already reached a limit.**
11. **Set the HOPR values to Set 2.**
12. **Set the LOPR values to Set 1 values for cavities that have not already reached a limit.**
13. **Raise GSET values by using the slider controls on the CMStress panel. The default routine is to make adjustments at 25% of the full scale of the slider. [Limits for each cavity will be preset by the LOPR and HOPR.]**
14. **Allow the tuners to settle after each change.**
15. **Note any faults and the conditions during fault. Logging routines will capture details, but try to notice real-time trends. If the same type fault occurs three times at the same field level while the cavity is tuned, do not attempt to raise gradient of that cavity any further. Turn that cavity down by 0.2 MV/m and leave fixed for the balance of the test.**
16. **If a cavity's tune seems uncontrolled, have rf tech or other qualified person tune up rf module parameters and consider manual tuning. [See the BRIAM SOS diagnostic process at <http://recycle.cebaf.gov/~doolitt/briam/sos.html>]**
17. **When GSET values have reached DRVH Set 2 values or otherwise maxed-out, leave GSET values stable for 1 hour, resetting faults, if any.**

Table 1: Stressing GSET levels, etc.

Zone	Cavity	Commissioning limit type	arcs 2/1-6/30	G4/9 DRVH	Set1	Set 2	Greal/Gset	
NL08	1	WGVF		5.00	8.8	11.00	1.03	*
NL08	2	WGVF	8	7.71	9.0	12.00	0.87	
NL08	3	Reflect Pwr		6.60	7.3	9.00	0.99	
NL08	4	WGVF	2	5.90	8.1	10.00	1.06	
NL08	5	BLVF	33	7.01	8.9	12.00	0.99	
NL08	6	Quench	31	4.01	7.7	9.00	1.11	
NL08	7	Quench	13	7.33	8.1	9.50	0.94	
NL08	8	CWAD	5	6.50	5.9	8.00	1.00	
NL09	1	CWAD		6.50	8.1	11.00	0.99	*
NL09	2	Reflect Pwr		6.20	8	11.00	1.01	
NL09	3	FE 1 Watt	1	5.10	8.6	12.00	0.94	
NL09	4	FE 1 Watt	23	6.40	7	8.00	0.95	
NL09	5	Quench		6.60	7.2	10.00	1.05	
NL09	6	FE 1 Watt		6.60	7.5	9.30	0.97	
NL09	7	FE 1 Watt	17	6.01	6.5	7.50	0.98	
NL09	8	Quench	12	7.00	8.1	9.50	1.03	
NL10	1	FE 1 R/hr	4	6.50	10.4	12.00	1.04	*
NL10	2	FE 1 Watt	59	5.55	6.6	9.50	1.12	
NL10	3	FE 1 Watt	2	6.50	6.5	12.00	0.97	
NL10	4	FE 1 Watt	1	4.70	4.7	7.50	1.13	
NL10	5	FE 1 Watt	36	6.30	6.9	9.50	1.11	
NL10	6	FE 1 R/hr	4	7.30	9.5	13.00	1.06	
NL10	7	FE 1 Watt		5.90	6.1	8.50	0.98	
NL10	8	Forward Pwr		5.80	9.3	11.00	1.00	

Table 1: Stressing GSET levels, etc. (Continued)

Zone	Cavity	Commission ing limit type	arcs 2/1- 6/30	G4/9 DRVH	Set1	Set 2	Greal/ Gset	
NL12	1	FE 1 Watt		8.20	9	11.00	0.90	*
NL12	2			6.80	9.7	12.00	0.97	
NL12	3	FE 1 Watt		5.10	9.8	12.00	1.34	
NL12	4	FE 1 Watt		6.10	9.8	12.00	1.12	
NL12	5	Quench		4.50	8.6	11.00	1.27	
NL12	6	Quench		6.00	10.4	12.00	1.00	
NL12	7	FE 1 Watt		6.70	8	10.00	0.92	
NL12	8	FE 1 Watt		5.30	6	7.20	1.21	
NL13	1	FE 1 Watt	32	6.51	7	8.50	0.93	*
NL13	2	FE 1 Watt	31	6.85	9.3	10.70	0.99	
NL13	3	Quench		5.10	9.2	11.00	1.08	
NL13	4	WGVF	1	5.40	9	11.00	1.03	
NL13	5	WGVF		4.30	9	11.50	1.72	
NL13	6	WGVF/ CWAD		6.90	10.9	12.00	1.05	
NL13	7	Quench	6	6.10	7.7	9.00	1.02	
NL13	8	Quench		5.60	6.3	8.50	0.85	
NL14	1	Quench	611	5.01	7.5	9.00	1.06	*
NL14	2	FE 1 Watt	77	5.45	5.45	5.45	1.14	poor Q
NL14	3	FE 1 Watt	6	4.50	8.2	11.00	1.01	poor Q
NL14	4	FE 1 Watt	38	6.00	6.7	8.00	1.14	
NL14	5	FE 1 Watt	59	5.33	5.33	5.33	1.10	poor Q
NL14	6	FE 1 Watt	199	5.05	8	10.00	1.14	
NL14	7	FE 1 Watt	109	5.47	6	8.00	1.10	
NL14	8	FE 1 R/hr		5.60	9	12.00	1.10	

Table 1: Stressing GSET levels, etc. (Continued)

Zone	Cavity	Commissioning limit type	arcs 2/1-6/30	G4/9 DRVH	Set1	Set 2	Greal/Gset	
NL16	1	FE 1 Watt	16	5.51	5.7	6.30	1.09	*
NL16	2	FE 1 Watt	5	7.80	9.2	11.00	0.94	
NL16	3	FE 1 Watt	57	5.71	7.5	8.30	1.20	
NL16	4	FE 1 Watt	9	6.24	6.8	8.00	1.05	
NL16	5	FE 1 Watt	29	5.75	8	11.50	1.05	
NL16	6	FE 1 Watt	2	4.10	7	10.00	1.12	
NL16	7	FE 1 R/hr	1	6.10	8.1	10.00	1.03	
NL16	8	Quench	26	6.49	8	10.00	1.02	
NL18	1	FE 1 Watt		5.00	6.50	7.00	0.83	*
NL18	2	FE 1 Watt	1	8.60	10.60	12.50	1.01	
NL18	3	FE 1 Watt		7.00	7.10	10.00	1.02	
NL18	4	FE 1 Watt		5.40	5.40	7.00	1.00	
NL18	5	Quench		7.40	7.70	8.50	1.07	
NL18	6	FE 1 R/hr		7.70	9.00	11.00	1.06	
NL18	7	Quench		7.30	8.10	10.00	1.09	
NL18	8	CWWT		9.50	10.60	12.50	0.96	
SL02*	1	FE 1 Watt	29	5.69	6.5	7.00	1.08	*
SL02*	2	FE 1 Watt	131	5.81	8.4	9.40	1.10	
SL02*	3	Quench/FE 1 R/hr	22	5.66	8.1	9.50	1.05	
SL02*	4	FE 1 Watt	399	5.46	8.3	9.50	1.06	
SL02*	5	FE 1 Watt	9	5.11	6.2	7.50	1.08	
SL02*	6	FE 1 Watt	3	6.21	10.7	12.00	1.04	
SL02*	7	FE 1 Watt	8	5.51	10.2	12.00	1.05	
SL02*	8	FE 1 Watt	166	5.77	6.3	7.70	1.04	

Table 1: Stressing GSET levels, etc. (Continued)

Zone	Cavity	Commissioning limit type	arcs 2/1-6/30	G4/9 DRVH	Set1	Set 2	Greal/Gset	
SL03*	1	FE 1 Watt		9.50	9.5	12.00	0.86	*
SL03*	2	FE 1 Watt		10.00	10.8	12.00	0.86	
SL03*	3	FE 1 Watt		10.00	11.3	13.00	0.81	
SL03*	4	FE 1 Watt		9.90	9.9	12.00	0.95	
SL03*	5	FE 1 Watt		5.20	5.2	6.00	0.89	
SL03*	6	FE 1 Watt	4	6.50	6.5	8.00	0.91	
SL03*	7	FE 1 Watt		10.00	10.8	12.00	0.96	
SL03*	8	FE 1 R/hr		7.70	7.7	12.00	0.84	
SL04	1	FE 1 R/hr	3	6.22	7.72	11.00	1.16	*
SL04	2	Quench		8.90	8.9	10.20	1.00	
SL04	3	FE 1 Watt		6.20	7	7.00	1.04	
SL04	4	FE 1 Watt	1	7.51	10.3	12.00	1.05	
SL04	5	FE 1 Watt	3	8.50	8.5	10.50	1.14	
SL04	6	Quench		5.70	5.7	6.50	1.05	
SL04	7	Quench		9.50	9.7	11.00	1.07	
SL04	8	FE 1 Watt		10.00	10.8	12.50	1.00	
SL05	1	FE 1 Watt	4	5.80	8.6	12.00	0.98	*
SL05	2	FE 1 Watt		7.00	9.2	11.00	1.08	
SL05	3	FE 1 Watt	1	7.40	9.5	12.00	1.05	
SL05	4	FE 1 Watt		4.50	10.1	12.00	1.46	
SL05	5	FE 1 Watt		5.90	5.9	5.90	1.07	
SL05	6	FE 1 Watt	7	7.80	7.8	10.00	0.79	
SL05	7	FE 1 Watt		7.60	7.7	9.00	0.76	
SL05	8	FE 1 Watt		6.50	9.2	11.00	1.07	

Table 1: Stressing GSET levels, etc. (Continued)

Zone	Cavity	Commissioning limit type	arcs 2/1-6/30	G4/9 DRVH	Set1	Set 2	Greal/Gset	
SL07	1	FE 1 Watt	6	4.50	6.1	6.10	0.81	*
SL07	2	FE 1 Watt	16	7.20	7.2	7.20	0.90	
SL07	3	FE 1 Watt	1	6.20	8.6	8.60	1.01	
SL07	4	FE 1 Watt		7.30	9.5	7.10	0.83	
SL07	5	FE 1 Watt	114	5.20	5.8	5.80	1.13	
SL07	6	FE 1 Watt	4	5.70	6.3	6.30	0.94	very poor Q
SL07	7	FE 1 Watt		5.81	5.81	5.81	1.07	
SL07	8	FE 1 Watt		6.00	6.9	10.00	1.09	
SL12	1	FE 1 R/hr	1	4.67	8.70	11.00	1.13	
SL12	2	FE 1 Watt	63	5.01	7.10	9.30	1.12	
SL12	3	FE 1 Watt	177	5.41	7.50	9.50	1.15	
SL12	4	FE 1 Watt	10	6.54	8.90	11.50	0.99	
SL12	5	FE 1 Watt		6.20	11.90	12.50	1.19	
SL12	6	Quench		7.36	8.60	10.00	0.98	
SL12	7	FE 1 Watt	34	6.30	6.20	8.20	0.89	
SL12	8	WGVF	2	5.42	6.50	8.00	1.12	
SL19	1	FE 1 Watt	147	5.95	7.4	9.50	1.09	*
SL19	2	FE 1 Watt	18	6.61	7.0	10.50	0.98	
SL19	3	FE 1 Watt	175	5.58	10.8	12.00	0.95	
SL19	4	FE 1 Watt	72	4.48	8.0	11	0.99	
SL19	5	FE 1 Watt	37	5.79	9.3	11.00	0.95	
SL19	6	CWAD	351	4.25	9.4	10.50	0.97	
SL19	7	CWAD	8	6.70	10.1	12	1.03	
SL19	8	CWAD		6.90	9.2	12.00	0.99	

Table 1: Stressing GSET levels, etc. (Continued)

Zone	Cavity	Commissioning limit type	arcs 2/1-6/30	G4/9 DRVH	Set1	Set 2	Greal/Gset	
SL20	1			5.76	6.00	10.00	1.09	**
SL20	2			7.32	7.47	10.00	1.00	
SL20	3			5.28	6.60	10.00	0.99	
SL20	4			7.44	7.00	10.00	0.98	
SL20	5			5.40	7.60	10.00	0.89	
SL20	6			4.80	5.40	10.00	1.07	
SL20	7			5.16	7.20	10.00	0.88	
SL20	8			4.56	6.10	10.00	1.07	

18. (Optional: If opportunity exists, sustain the present GSET values for up to 4 additional hours, resetting any faults if the time between faults for a given cavity is greater than 5 minutes.)

19. Return GSETs to DRVH Set 0 values.

20. Return DRVH to Set 0 values

21. Turn off RF.

22. Return tap settings to previous, either 7.35 or 10.6 as previously set.

23. Replace original download with previous GSETmax values.

24. Reestablish RF on and cavities at GSET=DRVH.

25. Suspend logging routine.

Test Results

Analysis - compare fault conditions with that seen in commissioning

- correlate detuning with gradient
- analyze fault valve vs. gradient, time, and forward power
- analyze CWWT vs. CRFP and tune
- analyze correlations between radiation dose and fault rate
- compare WG vacuum species between normal and extended windows
- μ phonics data at higher gradients